BCA’s and Pesticides in propagation
What about compatibility?

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What about compatibility?

When thinking about compatibility:

- Which pesticide?
- What BCA(s)?
- What crop?
- What stage of the crop → Propagation
- Where and when used?
- Plant residual effects?
- Greenhouse residual effect?
- Geographical location → Conditions
- Establishing or established population
- What is the impact on overall system of BCAs?
- ‘Slippery slope’ effect
What about compatibility?

What do we need to consider when thinking about compatibility?

- Which product?
- Which BCAs?
- Application technique (Spray, drench, drip, fog)
- Direct effect and/or residual effect

But above all:

- Is it really necessary to spray or are there other options?
- Do I need to apply everywhere or can I spot treat?
- **How did it get to this point?**
- How can I avoid this situation (in the future)?
- Is this going to affect my overall pest management program?

Different scenarios:

- ‘Slippery slope’ effect
- ‘Timing is everything’ effect
- ‘Calculated low risk’ effect → Propagation
Use Compatibility to your advantage

- **Types:**
  - Tank mix: sprays, drenches, dips
  - Short-term post application
  - Rotation/alternation

- **Resistance management (conventional chemistries and antibiotics)**

- **Reduced input programs (reduced chemical exposure)**

- **Clean-up/quick knock-down of chemical and extended protection by biopesticide**

- **Increased efficacy and cost efficiency (labor)**
General Characteristics of Foliar Biopesticides

- Act or respond immediately to many fungal and bacterial pathogens or insect pests
- Good coverage & proper concentration are critical
  - Only a few truly act systemically
- Require frequent reapplication or rotation with other products during typical disease or pest cycles
  - New growth of plant parts
  - Not persistent on aerial plant surfaces
- Compatible with many chemical- and bio-pesticides, and BCAs
General Characteristics of Soil/Root Biopesticides

- May act quickly or after a lag period
- Typically act via 2 or more modes of action
- Good distribution and proper concentration are critical – only a few act systemically
  - Bacteria require nutrients and free moisture to move, grow, act
  - Fungi are less dependent on moisture to move but still require nutrients for growth and competition in absence of pathogen
- Activity for 2-12 weeks, depending on the AI
  - Reappplication may still be needed to keep at effective levels
- Compatible with many chemical- and bio-pesticides, and BCAs
What is a ‘clean’ plant or cutting?
A ‘clean’ plant or cutting?

- Insect, mite and disease → what is acceptable?
- What about Pesticide residues? → what is acceptable
- Leaf tissue sampling for residues → affordable
- Zero tolerance.....is it possible?
- Producers of cuttings/Breeders → their actions can affect your program → ‘Clean’ plugs / plants are important for any pest management program
- Grower to breeders and propagators → your reaction can trigger their actions.
- Positive and constructive communication between breeder, propagator, and grower is very important!
- Growers requesting information
- Greenhouse vegetable industry as an example
- Start as early as possible = in propagation
Pest management and residues:

- More growers requesting information, especially those who are implementing BCA’s
- European regulations – residues (changed Jan 2015)
- Better future for ‘cleaner’ cuttings
- Bio-control and IPM at cutting production locations
- Bio-control / IPM at rooting stations
- Greater chance of success for end product growers

- Abamectin (Avid®)
- Buprofezin (Talus®)
- Fenazaquin (miticide)
- Pyridaben (Sanmite®)
- Pyriproxifen (Distance®)
- Spinosad (Conserve®)
- Spiromesifen (Judo®)
- Thiacloprid (neonic)
- Thiamethoxam (Flagship®)
- Novaluron (Pedestal®)
- Acethionate (Orthene®)
- Acetamiprid (Tristar®)
- Bifenthrin (Talstar®)
- Clothianidin
- Cyfluthrin (neonic)
- Imidacloprid (Marathon®)
- Lambda-cyhalothrin
- Methamidiphos (Monitor®)
- Methomyl (Lannate®)
- Omethoate
- Oxamyl (Vydate®)
What are the most common pest problems during propagation and what are the bio-control solutions?
Ornamental Propagation: The First Line of Defense

Seed and RC plug trays at rooting stations:
- Typical potential pest problems that are experienced later in the production cycle → Fungus Gnats, Thrips, Aphids, Whitefly and TSSM are most common
- Crop specific preferences.

BCA’s as first line of defense with Biocontrol approach:
- *Amblyseius cucumeris* or *Amblyseius swirski* depending on climate/pest/crop (sachet on stick)
- *Hypoaspis miles / Stratiolaelaps scimitus* (Hypoline™)
- *Atheta coriaria / Dalotia coriaria* (Staphyline™)
- *Steinernema feltiae* (Exhibitline™ sf)
- *Aphidius colemani* (with banker plants)
- Botanigard WP (*Beauveria bassiana*)
Ornamental Propagation: What can we still spray?

What can we use as a back up plan if problems arise?

- Carefully consider options → Check side effects on all BCA’s used in the system
- What is the target insect?
- What application technique (systemic or spray)?

What are Low Risk (‘Compatible’) products when/if needed:

- Botanigard WP (Insects, Frequency important)
- Mainspring GNL ® (Thrips, Aphids, Whitefly, Leafminer)
- Citation® (Fungus Gnats, Leafminer)
- Endeavor® (Aphids, Whitefly)
- Floramite ® (TSSM)
- Talus ® (Whitefly)
- Kontos ® (Whitefly)
Dipping

- Prevention with dipping unrooted and rooted cuttings
- Nematodes, Botanigard WP and Rootshield WP or Rootshield Plus
- Contact and conditions important for success with *Steinernema feltiae* and *Beauveria bassiana*
Thrips life cycle and BCA target!

- **Egg** (in cell tissue)
- **Larva** 1 & 2 (on plant → exposed)
- **Pupa** (in soil)
- **Adult** (on plant → exposed)

- 68°F 6 days
- 86°F 3 days
- 1.5 + 1.5 days
- 3 days
- 6 days
- up to 60 days
- 20 - 40 days

- Amblyseius spp
- Orius insidiosus
- S. feltiae
- Stratiolaelaps scimitus
- Dalotia coriaria
- S. feltiae
- Orius insidiosus
- S. feltiae

- Fecundity in vegetative stage vs when pollen is available
- Fecundity in different crops
Thrips life cycle and BCA and compatibility!

- **Egg** (In cell tissue)  [Image]
  - 68°F 6 days
  - 86°F 3 days

- **Larva 1 & 2** (on plant → exposed)  [Image]
  - 68°F 3 days
  - 86°F 1.5 + 1.5 days

- **Pupa** (in soil)  [Image]
  - 68°F 6 days
  - 86°F 3 days

- **Adult** (on plant → exposed)  [Image]
  - 68°F up to 60 days
  - 86°F 20 - 40 days

- **Amblyseius spp**
- **Stratiolaelaps scimitus**
- **S. feltiae** (Dalotia coriaria)
- **S. feltiae**

**Crop Beneficials**

- Botanigard WP
- Mainspring GNL ®
Where can you find more information about BCA and pesticide compatibility?
Bioline App:

- Information on Bioline App:
- Apple, Android and Microsoft compatible
- Compatibility data
- Trade name and A.I.
- Technical information per pest, BCA and strategies
- Free download from app store
Bioline App:
RootShield® Compatibility

RootShield® is a biological fungicide for the control of many root diseases. The active ingredient is a
living microbe (Trichoderma harzianum strain T-22) that protects the plant from pathogens.

The compatibility with RootShield® with other inputs has been tested extensively. The information
below is divided into three (3) tables: materials in the first table are fully tank mix compatible;
materials listed in the second table can be applied before or after the application of the compound;
the third table lists incompatible fungicides. For incompatible fungicides, BioWorks, Inc.
recommends that RootShield® be applied 10 to 14 days before or after chemical fungicide
application.

*Note: The products listed have been evaluated for their impact on RootShield’s active ingredient.
The impact of RootShield® on the listed actives has not been evaluated.

<table>
<thead>
<tr>
<th>Fungicides</th>
<th>Formulation</th>
<th>Tested Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active Ingredient</strong></td>
<td><strong>Brand Name</strong></td>
<td><strong>Concentration</strong></td>
</tr>
<tr>
<td><strong>Azoxystrobin</strong></td>
<td>Heritage™</td>
<td>3.6 oz/100 gal</td>
</tr>
<tr>
<td><strong>Bacillus licheniformis</strong></td>
<td>EcoGard® GN</td>
<td>128 fl oz/100 gal</td>
</tr>
<tr>
<td>strain 3086</td>
<td>SC</td>
<td>36 oz/100 gal</td>
</tr>
<tr>
<td><strong>Boscalid plus</strong></td>
<td>Pagean®</td>
<td>0.1 oz/gal</td>
</tr>
<tr>
<td>Pyraclostrobin</td>
<td>Captain® 85 WP</td>
<td>0.56 oz/gal</td>
</tr>
<tr>
<td><strong>Capsan</strong></td>
<td>Daconil® Ultra</td>
<td>3.2 fl oz/gal</td>
</tr>
<tr>
<td><strong>Chlorothalonil</strong></td>
<td>Lorasan® 4E</td>
<td>12 fl oz/100 gal</td>
</tr>
<tr>
<td><strong>Chlorpyrifos</strong></td>
<td>Stature®</td>
<td>50% FL</td>
</tr>
<tr>
<td><strong>Dimethomorph</strong></td>
<td>Banrot®</td>
<td>12 oz/100 gal</td>
</tr>
<tr>
<td><strong>Enidazole and</strong></td>
<td>FenStop®</td>
<td>50% WP</td>
</tr>
<tr>
<td>Thianthrene methyl</td>
<td>Medallion®</td>
<td>80% GA</td>
</tr>
<tr>
<td><strong>Fenamidine</strong></td>
<td>Chipco® 26019 Flo</td>
<td>2.0 fl oz/100 gal</td>
</tr>
<tr>
<td><strong>Fludioxonil</strong></td>
<td>Revra®</td>
<td>2.4 fl oz/100 gal</td>
</tr>
<tr>
<td><strong>Iprodione</strong></td>
<td>Subdue® Maxx</td>
<td>22.4% SC</td>
</tr>
<tr>
<td><strong>Metalaxyl-M</strong></td>
<td>Kontos®</td>
<td>12 oz/100 gal</td>
</tr>
<tr>
<td><strong>Spiran secrets</strong></td>
<td>Actinovate®</td>
<td>0.21 oz/gal</td>
</tr>
<tr>
<td><strong>Strepomyces lydicus</strong></td>
<td>Cleary’s 333®</td>
<td>Powder, Flowable</td>
</tr>
<tr>
<td><strong>WYEC 108</strong></td>
<td>TDC®</td>
<td>0.1 oz/gal</td>
</tr>
<tr>
<td><strong>Thiapentin methyl</strong></td>
<td>Bayleton® 25 T&amp;O</td>
<td>0.4 oz/gal</td>
</tr>
<tr>
<td><strong>Tridemeton</strong></td>
<td>Ronil® DF</td>
<td>0.04 oz/gal</td>
</tr>
<tr>
<td><strong>Vinclozolin</strong></td>
<td></td>
<td>0.01 oz/gal</td>
</tr>
</tbody>
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Biological Control in Spring Plugs / Propagation:

More locations this spring:
Some Real Examples of BCA’s and Compatibility
Real situation cut gerbera production ➔ ‘Slippery Slope’

- West coast grower using bio-control successfully since 1996
- Registration of Floramite® insecticide ➔ presented as compatible product
- Owner/grower makes decision to reduce introduction rate for *Phytoseiulus persimilis* ➔ Safety net = Floramite
- New planting after Mothers Day ➔ 2 year crop

Regular introduction rate
5 to 8 mites per m² for 3 to 4 weeks

Reduced introduction rate
2 to 3 mites per m² for 2 weeks
Real situation in cut gerbera production ➔ ‘Slippery Slope’

BCA’s used in cut gerbera:
- Amblyseius cucumeris
- Amblyseius swirskii
- Phytoseiulus persimilis
- Aphidius colemani
- Aphidius ervi
- Diglyphus isae
- Orius insidiosus
- Delphastus spp
- Aphidoletes aphidimyza
- Encarsia formosa
- Eretmocerus eremicus
Real situation in cut gerbera production → ‘Slippery Slope’

TSSM control is not going well → Floramite is used to reduce population however……:

- *Amblyseius cucumeris*
- *Amblyseius swirskii* = Negatively affected by Floramite (60 – 70 % reduction)
- *Phytoseiulus persimilis*
- *Aphidius colemani*
- *Aphidius ervi*
- *Diglyphus isae*
- *Orius insidiosus*
- *Delphastus spp*
- *Aphidoletes aphidimyza*
- *Encarsia formosa*
- *Eretmocerus eremicus*
Real situation in cut gerbera production → ‘Slippery Slope’

Whitefly control in cut gerbera:
- *Amblyseius swirskii*
- *Encarsia formosa*
- *Eretmocerus eremicus*

What happened next:
- Whitefly control is relying heavily on *A.swirskii* during summer months
- 3 weeks after Floramite application whitefly population explodes (life cycle)
- Not able to ‘repair’ with BCA →

Next decision is to drench with imidacloprid!
Real situation in cut gerbera production → ‘Slippery Slope’

Imidacloprid is used to ‘repair the whitefly situation, however………:

- *Amblyseius cucumeris*
- *Amblyseius swirskii*
- *Phytoseiulus persimilis*
- *Aphidius colemani*
- *Aphidius ervi*
- *Diglyphus isae*
- *Orius insidiosus*
- *Delphastus spp*
- *Aphidoletes aphidimyza*
- *Encarsia formosa*
- *Eretmocerus eremicus*

Note: Effect of imidacloprid on TSSM
Real situation in cut gerbera production → ‘Slippery Slope’

Thrips & Leafminer control in cut gerbera:
- *Diglyphus isae*
- *Orius insidiosus*

What happened next:
- Leafminer population increases rapidly
- Thrips population increases
- Looper population increases
- Not able to ‘repair’ with BCA →

Next decision is to stop bio-program all together
Pepper Crops and Compatibility – ‘Timing Is Everything’

Pepper crops:
Thrips is #1 pest problem →
- *Amblyseius cucumeris*
- *Amblyseius swirskii*
- *Phytoseiulus persimilis*
- *Aphidius spp*

*Orius insidiosus*
- Released in March → 4 introductions
- Total 1 per m² (10 sq. feet)
- Aphid control with BCAs critical during this time! WHY?
- Effect of Pymetrozine (Fulfill® insecticide) on *Orius* → reduction of 50% + 1 week residual
- 50% loss during establishment time = reduction and delay of establishment
Pepper Crops and Compatibility – ‘Timing Is Everything’

Pepper crops:

*Orius insidiosus:*

- Released in March → 4 introductions (1 to 2 per m² – 10 sq ft.)
- No interruption due to proactive approach on aphids
- July → *Orius* population = >100 *Orius insidiosus*/m² (10 sq feet)
- Aphid outbreak
- Effect of Pymetrozine on *Orius* → reduction of 50%, however…
- 50% loss of 100 vs. 1 per m²
- Remaining *Orius* will maintain control of thrips and re-establish!
Ornamental Propagation – ‘Low Calculated Risk’:

Seed and RC plug trays

- Typical potential pest problems → Fungus gnats and thrips
- Occasionally Aphids

BCA’s used during propagation:

- *Amblyseius cucumeris* (sachet on stick)
- *Hypoaspis miles* (Hypoline)
- *Atheta coriaria* (Staphyline)
- *Steinernema feltiae* (Exhibitline sf)

Compatible with the following insecticides:

- Citation®
- Endeavor®
- Mainspring GNL ®
*Amblyseius spp* (Amblyline Stick) and when needed compatible products during propagation
Tips for Developing Your Own Program

1. Think **proactive** or **preventive**: exclusion, sanitation, environment

2. Properly identify the disease and pest issues (don’t assume)

3. Determine which products, practices, and timings you are currently using for these and their costs in use

4. **Identify gaps in your current program:**
   - Efficacy
   - Resistance
   - Compatibility
   - Safety
   - Convenience
   - Market
   - Labor
   
   **How do you measure these?**

5. Define what success looks like
6. Contact manufacturer, other growers, and extension for advice: a lot of great application information is not on the label
   - Proper formulation for the crop, issue, and growing system
   - Compatibility with other products and BCAs

7. Test new products on a small scale before going “all out”
   - Set-up a good comparison
   - Integrate vs. replace

8. Document your tests
   - Keep track of what, how and when
   - Record what you and your staff see and experience
   - Photos: the good, the ugly, and the surprises

9. Keep an open mind
Decision-Making Considerations

Cost in Use: actual cost to use a product in a program:
- Product cost
- Cost per application: product, labor, and equipment
- Number of applications per crop
- Number of diseases or pests controlled by product
- Non-target effects of product on plants and BCAs

Actual Benefits: direct and indirect
- Cost savings: Same or improved efficacy with lower cost in use
- Increased productivity: low REI, low/no PHI
- Greater plant safety (low phytotoxicity)
- Greater worker safety
- Lower resistance to conventional fungicides and insecticides
- Greater compatibility with other inputs
Compatibility → Important Keys to Success:

- Think carefully and investigate before jumping the (spray) gun
- Check **before** application!
- Is it really necessary to spray or are there other options?
- Is the situation close to or past ‘tipping point’?
- Determine → ‘Slippery Slope’, ‘Timing Is Everything’ or ‘Calculated Low Risk’ with choice of pesticide
- When successful with BCA’s……stick with appropriate release rates!
- Propagation is an important part of production process for bio-control and integrated approach → Foundation of rest of the crop!!
- Often in more complex systems (such as cut & potted gerbera) applying a full house application can trigger the ‘beginning of the end’ effect.
- ‘Calculated low risk’ products and BCA → Resistance management!!
- If absolutely necessary, choose the best possible option and think about what the possible outcome might be on other pest problems and BCA’s
- Check out: Bioline app → Side effects
Biological control is preventing problems, not fixing them!

Bio-control works!

It is people (managing) that makes bio-control an effective strategy!
Thank You!

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